AN AMERICAN WILD FLOWER.

In a sequestered corner of the rockery whose trickling fountain feeds this careless little English garden, a cluster of scarlet New England columbine grows lustily from a dry nook of scanty black soil. They are aliens here, those wild American woodland bells, with their graceful hanging blossoms and their native beauty of untampered form; for they are by birth citizens of the State of New York, and they waved originally on a solitary granite rock among the Thousand Islands, not far from the exquisite reaches and dotted rustic villas of Alexandria Bay. The islet from which I gathered that knotted root, as one trophy of a delightful botanizing campaign in lands beyond the sea, was but a mere boss of rounded rock, worn smooth by grooving glaciers of the great ice age, and thinly covered by a shallow sheet of rich vegetable mold; but on its top sprang many treasures which, beautiful in themselves, have for the European naturalist all the added charm of novelty and surprise. A red cedar or two overhung the water's edge with feathery branches dipping low to the level of the stream; a thicket of huckleberries spread beneath the shadow of green Canadian spruces; and innumerable spring flowers blossomed underfoot in all the wild profusion of American spring-tide. There were blood-roots, with their waxen, creamy blossoms and their thick bleeding stocks; there were May-apples, with their green Japanese parasols cleft in the stalk to find space for the dainty snow-white bloom; there were great three-leaved trilliums, red and pale; there were cup-shaped hepaticas, and adder's-tongue lilies, and stars of Bethlehem, and yellow violets, and creeping winter-green; and in the moldering bole of one decayed pine-stump there was this identical clump of ragged orange and scarlet columbines. A trowel soon transferred them, mold and all, to an Indian parti-colored woven basket; and after undergoing many changes and reverses

by sea and land, here they are at last, flowering as bravely on this wee strip of Kentish hill-side as ever they flowered in their native soil behind the endless blue mazes of the broad St. Lawrence.

Even if I did not prize those red columbines as the living souvenir of a charming tour among the loveliest tangled water-scenery of the whole world, I should prize them for their own sake as beautiful natural blossoms of singular gracefulness and unrivaled delicacy. All the columbines are pretty enough after their kind—have they not even given their name to that incarnation of airiness, the flitting fairy of our old-world pantomime?—but there is not one among them so absolutely dainty and pensile, so perfect an embodiment of the generic ideal, as this red New England and Canadian form. The European columbines of Alpine meadows are meritorious flowers in their own way, but they are heavy, clumsy, overgrown things beside these truly wild woodland blossoms. Ours have a half cultivated, sophisticated look, while the American type has a through-going wildness and freshness of aspect which is wholly wanting to the European form. It is often so, when one contrasts allied plants of the two continents: the older hemisphere has had its whole flora degraded by the excessive prevalence of meadows, pastures, and corn-fields; the blossoms of the newer hemisphere breathe rather the native beauty of open prairie or of primeval forest. In England, we go to look for flowers in the fields; in America, you go to look for them in the woods; and that one prime difference of habit implies a thousand pretty minor differences of form and aspect.

Each separate bell of the scarlet columbine is well worth minute examination in detail; for there are few flowers which have undergone such profound modification as this in adaptation to the fertilizing visits of insects. If one looks closely into the structure of the blossom, one can see that it consists of four distinct parts or whorls, three of which contain five members each. The outer whorl or calyx answers to the green cup which incloses the flower-bud in most ordinary blossoms; but in the scarlet columbine it is colored bright red like the rest of the bell. Clearly, for some good reason of its own, the columbine has chosen to withdraw the calyx in part from its usual protective function, and to devote it instead to supplementing the attractive display undertaken as a rule by the petals alone. Each separate leaflet of the calyx, however, is flat in outline, and does not differ

conspicuously in shape from the calyx-pieces of other flowers. But it is quite otherwise with the petals. These, as everybody has often noticed, are not simply shell-shaped or saucer-shaped, like those of a rose or a buttercup, but are prolonged into deep tubular spurs, each protruding between and behind the nearest calyx-pieces, so as to give the entire flower its peculiar horned appearance. In fact, if you pull out a single petal of the columbine, it looks for all the world like the cornucopia of old-fashioned symbolical sculpture, with a wide-open mouth and a small, narrow, tapering bottom. The explanation of these curious petals really sums up the whole past evolutionary history of the flower. Inside the petals, again, come the numerous stamens, the organs which produce the golden fertilizing pollen; and finally, inside the stamens, comes a single row of five carpels or unripe seed-capsules. So much of structural detail is absolutely necessary before we can begin to unravel the strange story of the columbine's past transformations.

And now, where did the scarlet columbine come from, and by what steps has it reached its present condition? Well, by origin and family it is a common meadow buttercup; and though it is one of the most advanced and most highly differentiated of the buttercup group, it still retains many unmistakable signs and relics of its half-forgotten lowly ancestry. The buttercups, of course, are among the very simplest existing types of flowering plants; you can see as much at a single glance into the center of their brilliant, golden saucers. Just pick one for comparison with the scarlet columbine, and note carefully the little points of agreement and of difference. An ordinary yellow field buttercup out of any meadow around you will do, for they are as plentiful in America as in England; not native-born Americans, it is true, but naturalized citizens of the United States, having followed the footsteps of the white man, with the clover-seed and the wheat, over the whole face of the civilized globe. In fact, a very large proportion of the American meadow and wheat-field weeds, like the plantain and the chick-weed, are European plants by origin; and that accounts for the broad distinction which exists in America for the popular mind between weeds and wild flowers. In England, such a distinction is hardly felt at all; every one of our native plants is a member of the self-same scrubby north European flora, with its much-degraded over-civilized types. But in the States, you can discriminate at once between the shabby

straggling weeds of cultivation, introduced into fields or gardens with English grasses or cereals, and the true native woodland wild-flowers, that grow now as they grew a thousand years ago beneath the shade of green American pines and maples. The buttercup belongs to the first or imported class; the columbine falls rather under the second or thoroughly indigenous division. Did not even the red Indian of early colonial days note the difference, and pathetically describe our English ribwort as the white man's footstep, because it seemed to spring of itself wherever the sole of the intrusive pale-face had once been planted?

Our meadow buttercups, then, are very simple, central or typical flowers, hardly altered in any way from an extremely primitive ancestral form. They have each five little sepals or calyx-pieces, inclosing five bright golden petals, both of the most ordinary or unspecialized shape. Within these they have a mass of yellow stamens, and in the very center a whole scattered group of separate small carpels or unripe fruits. There is nothing that marks a primitive flower more than this separateness and distinctness of the carpels. You find it in every very early type; for example, in the water-plantains among the monocotyledonous plants, and in the potentillas and buttercups among the dicotyledonous plants. Moreover, in all such very ancient types, the carpels are also extremely numerous. On the other hand, as soon as plants begin to advance in organization, we can always observe that the carpels become fewer in number; because higher types acquire surer means of fertilizing their seeds, and are thus enabled to dispense with some of the supernumerary capsules. Again, the simplest plants have always only one seed in each carpel; and therefore it is necessary that a separate act of fertilization should take place for each seed. In the buttercup, for example, the bee must deposit a few grains of pollen on the sensitive surface of every separate carpel, out of the twenty-five or thirty of which the compound fruit is composed; and if he misses any one carpel, that particular little capsule never sets its seed at all. This is a clumsy and expensive mode of getting fertilized, and higher plants have devised a better plan for avoiding the difficulty; they produce fewer carpels, but put more ovules into each of them, so that one act of fertilization suffices for a whole batch of embryo seeds at once. Moreover, in most higher types the carpels are not distinct from one another, but are welded together into one head, as in the poppy, where the cells of the

fruit represent so many originally separate individual capsules. The immensely increased security for fertilization thus effected naturally gives the plant a great advantage in the struggle for existence; and we find accordingly that most modern flowers have their carpels so welded together into a single compound pistil. Only a few early types here and there now survive to keep up the memory of the older separate condition.

But why does the bee visit the buttercup at all? Of course, for the sake of the honey. If you pull out one of the golden petals from the flower, you will see that on the claw or base, near where it joins the stem, there is a little hollow dark-colored spot on its upper surface, covered by a tiny convex scale. You will not need a magnifying glass to see the spot or the scale; they are quite clearly visible to the naked eye. If your buttercup is a fresh one, which has not already been rifled by some adventurous bumble-bee, you can see a tiny drop of liquid oozing from the spot on lifting up the scale with the point of a needle. Put your tongue to the gland, and you will find the liquid it distills is honey. The little thickened spot on the petal is the buttercup's nectary; and the convex scale on top of it is put there to protect the honey from small unauthorized insect thieves, which might otherwise steal it without benefiting the plant in any way. With the bee, or any other recognized fertilizer, the case is different. For the pollen-sacks of the buttercup ripen before the sensitive surfaces of the carpels are mature, beginning from the outside inward, and each stamen as it ripens turns toward the nectary and away from the center of the blossom where the carpels are situated. As soon as the pollen-sacks have all shed their golden dust, the carpels in turn begin to mature for impregnation, and their sensitive surfaces grow viscid, so as to receive the pollen-grains fron some other flower. Now, when a bee alights upon a buttercup head, he generally poises himself on the carpels in the center, and proceeds systematically to search the five nectaries, one at the base of each petal, for their store of honey. If the blossom is in its first or pollen-shedding stage, he merely dusts over his hairy breast and legs with the fertilizing grains, which he carries off to the next flower he visits. But when he comes to one which is in its second stage, with the carpels mature, he unintentionally rubs off the pollen from his body on to the sensitive surfaces, which are now covered with a sticky secretion, in order to retain it. As he has to turn once right round on his

own axis (so to speak), in rifling the five nectaries, one after another, he is pretty sure to impregnate every one of the numerous carpels in the course of his slow rotation. That, indeed, is the sole object of the entire mechanism: the drops of honey are there to allure him; the bright petals are there to advertise its presence; the pollen is there to fecundate the young seeds; and the carpels themselves are there in order to be duly impregnated by the fertilizing dust.

But why does not the pollen simply drop from the stamens on to the carpels? Why all this interaction of bee and honey and bright color, merely to secure an end which might seemingly be just as well compassed by so easy a plan as that of trusting to unconscious gravitation? Because the object nature has in view is not fertilization alone, but cross-fertilization. Breeding in and in, close intermarriage, or whatever else we choose to call it, always ends in the long run in infertility; a little infusion of fresh blood, the introduction of a new strain, always produces stronger and healthier offspring. Hence, all the best and most advanced plants are provided with elaborate devices for getting the pollen of one flower carried by insects, birds, or wind to the carpels of another; and the greater number of kinds really differ from one another mainly in the methods by which they secure this primordial necessity of their constitution.

Look away now from the buttercup to the scarlet columbine, and let us try to see what are the points of superiority which have made the more developed flower rise from the condition of the lower one; and first, let us examine the petals, which strike the keynote of all the other changes. These petals, as we have seen already, are produced behind into long spurs, which end in a blunt knob or pocket. No country child on a New England farm needs to be told that those knobs contain a drop of pure, luscious honey; we have all bitten them off over and over again when we were children, for the sake of their sweet contents, just as we have all sucked the nectar of clover and honeysuckle, or as we have all stolen the store of sugary juice from the crimson recesses of the Carolinian trumpet-creeper. Now, at first sight, it is hard to see how these funnel-shaped petals of the columbine—little blind alleys leading at last into a *cul-de-sac* of distilled honey—can ever have been developed from the saucer-like petals of the buttercup. But if we bear in mind the peculiar position of the nectary on the buttercup petal, it is not so difficult to

understand the transformation as it would appear to be on the first blush of the thing. Suppose, for a moment, you were still further to depress the little hollow under the scale of the buttercup, what would you get? Why, the faint beginning of such a tube as that of the columbine. And suppose you were to go on indefinitely with the same process, what would you get? Why, the columbine petal itself.

That, indeed, is clearly the right way to look at it. The petal of the columbine is just the petal of the buttercup, with the tiny depression or hollow of the nectary prolonged backward into a tubular spur. And how or why did this prolongation come about? Well, we must remember that though most buttercups have got the nectary covered by a scale, they have not all got it so; and what is very significant, the scaleless kinds are among the most primitive in type of the whole family. Hence, we may fairly conclude that the very earliest buttercups of all had only a naked nectary on each petal, as is still the case in the common water-crowfoot, which brightens many still ponds or shallow ditches throughout the States with its pretty faded yellow or whitish blossoms. But there are two conceivable ways in which such plants might guard their honey from the depredations of thieving small insects, who steal the nectar without fertilizing the embryo seeds. One way would be by developing a lid or cover, like the scale of the meadow buttercup; the other way would be by hiding it at the bottom of a long spur or tube, not too deep to be probed by the big proboscis of a bee or a butterfly, but quite beyond reach of tiny, useless midges or pickpocket flies. Whatever plants happened to vary in either of these two directions would more often be properly fertilized than any others; and so the tendency, once set up, would be sure to be increased by natural selection; and that such tendencies would be set up we know to a certainty, both *a priori*, because all plants and animals are always spontaneously varying in all conceivable directions, and *a posteriori*, because here are the buttercups and the columbines themselves to answer for it that they did.

The buttercups have solved the problem how to secure their honey from plunderers in the first of these two ways; but a great many of their relations, common descendants of the same primitive ancestor, have solved it in the second. They have utilized the whole petal as a sort of long sack to contain honey. We see the first indication of such a habit in the group known as

hellebores, which have the petals curled round into a comparatively short tube, full of honey. In the scarlet columbine, the tube is much longer and rather bent, so as to keep out small insects; while in the wild English columbine it is far more curved, in accordance with several other marks of higher development. In the larkspur, which is also a very advanced form of buttercup, there are only two petals, the other three having disappeared by disuse; and these two are prolonged as honey-jugs under shelter of a covering and protecting spur formed by one sepal of the calyx. And in the blue monk's-hood or aconite there are also, as a rule, only two petals, though rudiments of the other three still occur in some kinds; and these two remaining petals are similarly made to do duty as nectaries, being concealed under the large blue sepal which forms the hood or cowl whence the flower takes its appropriate and significant English name. In all these cases, then, the petals are really highly developed forms of the buttercup petal, with the nectary much more pronounced and greatly specialized for its acquired or remodeled function.

Notice, too, that the color of the flower varies generally with the point it has reached in the ascending scale of development. The buttercup is golden-yellow, and so are almost all other very simple and primitive blossoms. But it has been shown that as flowers become more complex they tend to pass through a certain regular gradation of tints: from yellow, the common starting-point, they go upward through white to pink, red, purple, and finally blue. Now this gradation is beautifully illustrated in the buttercup family, and very particularly so in the scarlet columbine. For while the common buttercups are all yellow, many of the higher Alpine species are pure snowy white; and so also is that pretty Tyrolese hellebore cultivated, both in English and American gardens, under the name of Christmas rose. The scarlet columbine, again, which stands higher in the scale is red, but not wholly so. If you look carefully at the petals, you will see that the lower and broader portion, which most closely represents the original buttercup petal, is often still bright yellow; it is only the more highly developed part, the long tube which represents the greatly elongated nectary, that has assumed a deep glow of brilliant scarlet. In fact, the color passes slowly, as the funnel narrows, from yellow to orange and from that again to blushing red. The buds, too, are yellower

than the open blossoms, which clearly suggests to one which is in reality the original and which the acquired color. The English columbine, which is a more developed type, is never yellow in the wild state, but often purple, and sometimes blue. Larkspur, once more, ranking still higher in the floral scale, in virtue of its singular bilateral blossoms, is usually blue, though it sometimes reverts to reddish-purple or white; while monk's-hood, the very top of the tree on this line of development, is usually deep ultramarine, only a few species being prettily variegated with pale blue and white. As a rule, blue flowers are the very highest; and the reason seems to lie in the strange fact, first discovered by Sir John Lubbock, that bees are fonder of blue than of any other color. Still, they are fond enough even of red; and one may be sure that the change from yellow to scarlet in the petals of the American columbine is due in one way or another to the selective tastes and preferences of the higher insects.

The remaining points of variation in the columbine are all dependent ultimately on this prime variation in the shape and construction of the tubular petals. By thus storing all its honey in a deep vase, like the stork in the fable, the columbine keeps away all useless depredators, and, therefore, all the more encourages the visits of legitimate insects—guests with a long proboscis, such as bees and butterflies. But, in order to do so, it must attract them by its color; and as the petals alone are now hardly sufficient for this task, it has acquired a bright pigment in its calyx as well. The American scarlet columbine, a comparatively undeveloped species, has the calyx still rather greenish, though tinged with the same crimson as the spur; in the English columbine and most other highly developed types, the calyx is larger and more expanded, it has lost all trace of greenness, it is colored blue or purple, and it serves almost entirely for display, the petals doing duty as honey-glands only. Indeed, as a general rule, one may say that, where the calyx is much exposed to view, it tends to become as brightly colored as the petals, and often supersedes them altogether. In the buttercups, the petals alone are bright golden; in the globe-flower, the large sepals cover and almost conceal the small petals, and they are therefore just as brilliant a yellow as the petals of the buttercup; in the marsh-marigold, as common a plant by the water-side in America as in Europe, the useless petals have been suppressed, and the sepals alone do duty as insect attractors. All these flowers are bright

yellow. It is just the same, however, with the scarlet, or white, or purple anemones, which have similarly got rid of the functionless petals. In the columbine, the petals and sepals are both colored, and both serve to heighten the effective display. In the hellebores, the petals are almost unseen, being hidden within the converging cup-shaped calyx; and in larkspur and monk's-hood they are quite concealed by the spur or hood which has usurped their original function. But in all these last cases, the petals still survive, though often in reduced numbers, because they are useful to the plant in a new capacity—no longer as advertisements, but as storers of honey.

At the same time that the sepals and petals have undergone these curious transformations the carpels also have been reduced in number to a single whorl of five. The bee, alighting now on the center of the blossom, is able readily to fertilize these five, as he turns about from one to another of the five long tubes and thrusts his flexible tongue into their deep recesses. Moreover, each carpel, instead of containing only one seed, now contains a whole row, a change which was already begun in the marsh-marigold and the globe-flower, and which is also found in the hellebores. These, however, had each many carpels, like the buttercup, while the more advanced columbines have been able to bring down the number to five. Finally, in the extremely developed monk's-hood, by a more advanced economy, the carpels have been further reduced to three, while in the larkspur there is only one. To the last, however, there is no union between the separate carpels, as in the poppy; and it is that peculiarity which enables us to trace so confidently the origin of all these highly evolved types directly from the very simple and primitive buttercups. Many other things might one find to say about the scarlet columbine; but life is short, and science is long, even longer than art; so perhaps this is as much as a busy world has time to hear in one day about a single woodland American flower.

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